# CBD & SOUTH EAST LIGHT RAIL PROJECT

(RANDWICK CITY COUNCIL & UNSW AREA)

# TECHNICAL REVIEW – TRAFFIC ENGINEERING & ROAD SAFETY

*(DECEMBER 2013)*


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## APPENDICES

NIL

Our Reference: G16042R-01B.doc

VERSION HISTORY

| Version | Date | Type | Prepared By | Approved By |
|---|---|---|---|---|
| A | 07/11/2013 | Draft Report | A. Coyle / N. Green | A. Coyle |
| B | 11/12/2013 | Final Report | A. Coyle / N. Green | A. Coyle |
| | | | | |



# 1 INTRODUCTION

Traffix Group Pty Ltd has been engaged by Randwick City Council and University of New South Wales to provide independent technical advice regarding the proposed CBD & South East Light Rail project.

# 2 ASSIGNMENT SCOPE

The purpose of this assignment is to provide independent technical advice regarding the proposed CBD & South East Light Rail project to ensure that the project best meets the objectives and vision of Randwick City Council and University of New South Wales.

The plans prepared by Transport for New South Wales have been reviewed and the sites inspected with representatives from Randwick City Council and University of New South Wales.

In particular, the review focussed on key issues such as:

- Location - Surrounding Land Uses, Land Acquisition.
- Layout - Platform Size, Storage, Swept Paths.
- Access - Crossing Points, Ramps, Illegal Access, Safety, Footpath / Shared Path, Vehicle.
- Intermodal - Sharing of Tracks, Bus Stops, Bus / LRV Transfer, Bus Priority.
- Signal Operation – Overview, LRV Movements, Bus Movements, Pedestrian Movements, Traffic Impacts.

# 3 CBD & SOUTH EAST LIGHT RAIL PROJECT

The CBD & South East Light Rail Project (the 'Project') is a new light rail line extending 12 kilometres from Circular Quay along George Street to Central Station, then to Kingsford via Anzac Parade and Randwick via Alison Road.

Key features of the project include:[1]

- nine stops between Circular Quay and Central Station.
- seven stops between Kingsford and Central Station, including the University of NSW at Anzac Parade and Moore Park.
- six stops between Central Station and Randwick, serving the Prince of Wales Hospital, University of NSW at Wansey Road, Randwick Racecourse and Moore Park.
- interchanges located at major rail stations – Central Station, Town Hall, Wynyard and Circular Quay and bus interchanges at both Randwick and Kingsford.
- pedestrian zone from Bathurst Street to Hunter Street with light rail operating through the centre.
- segregated traffic and light rail lanes between Central Station and Bathurst Street and between Hunter Street and Circular Quay.

Key benefits include:

- Increased capacity:
  - space for 300 commuters on each 45 metre long light rail service – equivalent to five standard length buses.
  - reduced crowding and congestion.
  - buses freed up to service other destinations.
- Faster, simpler, more reliable services:
  - 'turn up and go' services every two to three minutes in peak times.
  - 97 per cent reliability.
  - services that are on time and fast.
  - real time information at all stops and on vehicles, showing route and stop locations.
  - simple to navigate.
  - effective wayfinding at stops and interchanges, to help you transfer to bus, ferry or heavy rail.
- Urban renewal opportunities:
  - pedestrian friendly streets, open spaces and revitalised public areas
  - reduced congestion at the heart of the CBD
  - a more attractive, accessible environment for visitors, businesses and workers
  - improved connections where people live, work and visit.
- Improved amenity:
  - integrated, electronic ticketing available at outlets or on-board
  - light rail stops maximise accessibility, with multiple doors available to alight at your stop
  - smooth, comfortable and quiet services, with air-conditioned vehicles
  - safe, clean, accessible and comfortable environment.

An overview of the project is shown in Figure 1. The study areas for this investigation are highlighted in red.


Source: http://www.transport.nsw.gov.au/lightrail-program/cbd-and-south-east-light-rail

Figure 1: Project Overview and Study Areas

[1] Source: http://www.transport.nsw.gov.au/lightrail-program/cbd-and-south-east-light-rail

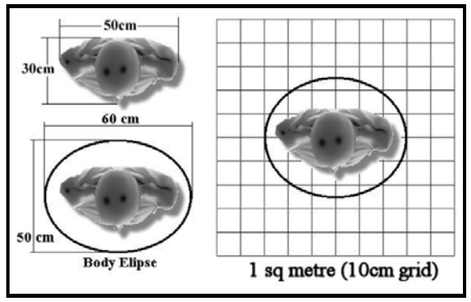
# 4 REFERENCE DOCUMENTS

The following documents were reviewed during the preparation of this report:

- Transport Operations Report, Final Report, Transport for NSW, 8 October 2013, Sydney.
- CBD and South East Light Rail Engineering, Light Rail Systems and Urban Design Definition Design - Volume 3 - Part 1 - South East Corridor, Final, CSELR-00WP-GN-R-0019, prepared for Transport for NSW, 16 August 2013.
- CBD & South East Light Rail Engineering, Light Rail Systems and Urban Design Definition Design Report - Volume 4 - Urban Design, CSELR-OOWP-GN-R-OO20, Final, prepared for Transport for NSW, 16 August 2013.

# 5 PEDESTRIAN LEVEL OF SERVICE

The Victorian Rail Industry Operators Group Standards VRIOGS 002.1 Railway Station Design Standard and Guidelines (Revision A, 29/03/2011) includes details of the Fruin Levels of Service. It is a concept used in the design of places of public assembly and uses typical body ellipse (see below) to represent the space occupied by a person without touching an adjacent person i.e. it is slightly more than the space occupied by the physical person.




Source: Victorian Rail Industry Operators Group Standards VRIOGS 002.1

Figure 2: Body Ellipse

| Fruin Level of Service | Area Per Person Square Feet | Sq Metres | Edge Feet | Edge Metres | Density |
|---|---|---|---|---|---|
| LoS F | 5 | 0.46 | 2.24 | 0.68 | 2.17 |
| LoS E | 10 | 0.93 | 3.16 | 0.96 | 1.08 |
| LoS D | 15 | 1.39 | 3.87 | 1.18 | 0.72 |
| LoS D | 20 | 1.86 | 4.47 | 1.36 | 0.54 |
| LoS C | 25 | 2.32 | 5.00 | 1.52 | 0.43 |
| LoS B | 30 | 2.79 | 5.48 | 1.67 | 0.36 |
| LoS B | 35 | 3.24 | 5.92 | 1.80 | 0.31 |
| LoS A | 40 | 3.72 | 6.32 | 1.93 | 0.27 |

Source: Victorian Rail Industry Operators Group Standards VRIOGS 002.1

Figure 3: Fruin Level of Service

The widths of key station elements – ramps and stairs – can be tested using a level of service approach whereby the recommended width is calculated by:

Width required = pedestrians/unit time/service level flow rate.

The service level flow rates normally adopted are shown in Figure 4

| | Flow Rate (pedestrians/m/min) | |
|---|---|---|
| Service Level | Walkway or Ramp | Stair |
| A | 23 | 16 |
| B | 28 | 20 |
| C | 41 | 26 |
| D | 58 | 38 |
| E | 74 | 49 |

Source: Victorian Rail Industry Operators Group Standards VRIOGS 002.1

Figure 4: Ramp Flow Rates & Service Levels

This information can be used to assess the key LRV stop elements.

# 6 PASSENGER BOARDING & ALIGHTING VOLUMES

The 'Transport Operations Report, Final Report, Transport for NSW, 8 October 2013, Sydney' provides information regarding predicted passenger boarding and alighting numbers as well as bus transfers and walk ups. Daily pedestrian movement data (by location and mode at each of the main access points) was provided by UNSW and are presented in Figure 4 and Figure 12. A summary of this data is provided in Table 1.

Table 1: Passenger Boarding & Alighting Volumes

| Location | Transport Operations Report Predicted Volumes (AM Peak Hour*) | UNSW Data Existing Volumes (Daily) |
|---|---|---|
| Wansey Road / High Street Stop (UNSW) | Precinct Access Plan (Table 7-21) states:<br>749 boardings & 2,188 alightings forecast for 2021 (total – 2,937 per hour).<br>842 boardings & 2,803 alightings forecast for 2036 (total – 3,645 per hour). | High number of daily arrivals (11,957) from the gates in High Street near Wansey Road, with approximately 80% (9,525) by public transport.<br><br>There is also a high number of daily departures (9,607) to the existing gates in High Street, with approximately 74% (7,087) by public transport.<br><br>Entries (alightings for public transport passengers):<br>Max. - 632 per 15 minutes.<br>95th Percentile - 352 per 15 minutes.<br><br>Exits (boardings by public transport):<br>Max. - 387 per 15 minutes.<br>95th Percentile - 279 per 15 minutes. |
| Anzac Parade UNSW Stop (UNSW) | Precinct Access Plan (Table 7-16) states:<br>626 boardings & 1291 alightings forecast for 2021 (total – 1,917 per hour).<br>708 boardings & 1673 alightings forecast for 2036 (total – 2,381 per hour). | High number of daily arrivals (17,662) from the gates in Anzac Parade near University Mall, with approximately 74% (13,110) by public transport.<br><br>There is also a high number of daily departures (20,050) to the existing gates in Anzac Parade near University Mall, with approximately 76% (15,323) by public transport.<br><br>Entries (alightings for public transport passengers):<br>Max. - 898 per 15 minutes.<br>95th Percentile - 579 per 15 minutes.<br><br>Exits (boardings by public transport):<br>Max. – 1,143 per 15 minutes.<br>95th Percentile - 594 per 15 minutes. |
| Strachan Street Stop (Council) | Precinct Access Plan (Table 7-17) states:<br>802 boardings & 84 alightings forecast for 2021 (total – 886).<br>1024 boardings & 99 alightings forecast for 2036 (total – 1,123). | - |
| Kingsford Tram Stop & Terminus (Council) | Precinct Access Plan (Table 7-18) states:<br>1454 boardings & 515 alightings forecast for 2021 (total – 1,969).<br>1851 boardings & 615 alightings forecast for 2036 (total – 2,466). | - |

* It is noted that it has been assumed that the patronage stated in the tables are from Tables 7-16, 7-17, 7-18 and 7-21 are AM Peak Hourly Volumes although it is not stated in the table.

The above volumes were used to calculate the likely passenger loadings at each of the stops, and using the information in Section 5, determine the expected level of service of the stop platforms.

# 7 WANSEY ROAD / HIGH STREET STOP (UNSW)

The proposed Wansey Road / High Street stop will service the upper campus of UNSW.

## 7.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 5 and Figure 6 and are summarised as follows:

- Unsignalised T-intersection (priority along High Street). Left turn slip lane on west leg. University vehicle access immediately east of intersection.
- Pedestrian 'zebra crossing' on east leg. Pedestrian refuges on west leg. Existing shared path along west side of Wansey Road.
- Bus routes along High Street. Bus stops located to the east and west of the intersection.
- Pedestrian access to UNSW's upper campus.
- Large numbers of public transport (bus) passenger accessing bus stops on High Street.

Source: http://maps.six.nsw.gov.au/

Figure 5: Wansey Road / High Street – Existing Conditions

View North to Wansey Road

View West along High Street

View East along High Street

View West to High Street Pedestrian Crossing

View South to UNSW Entrance

View North from UNSW Entrance to High Street

Figure 6: Wansey Road / High Street – Photographs

Daily pedestrian movement data (by location and mode at each of the main access points) was provided by UNSW and are presented in Figure 7. This shows the high number of arrivals (11,958) from the existing bus stops in High Street near Wansey Road, with approximately 80% (9,500) by public transport. There is also a high number of departures (9,607) to the existing bus stops in High Street, with approximately 74% (7,100) by public transport.

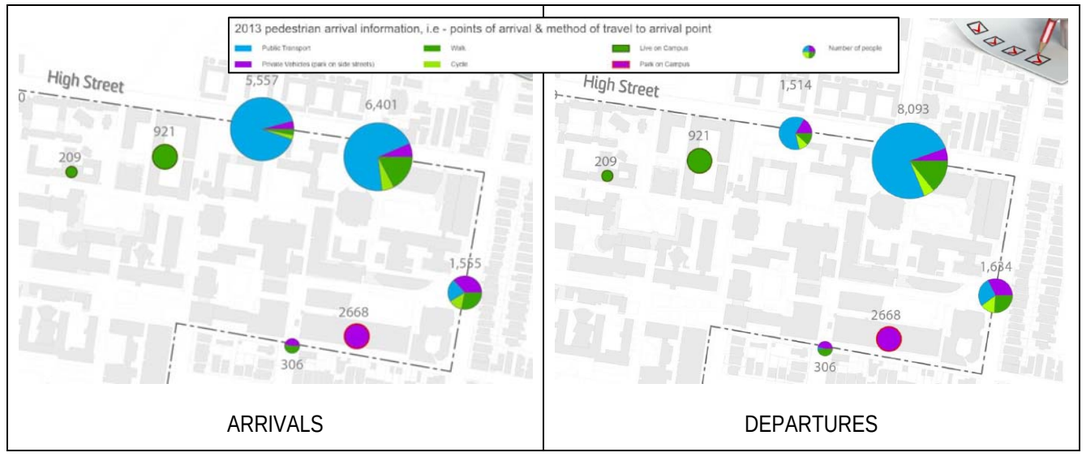



Figure 7: UNSW Daily Pedestrian Movements - by location by mode

Figure 8 presents the breakdown of pedestrian movements in 15 minute intervals.

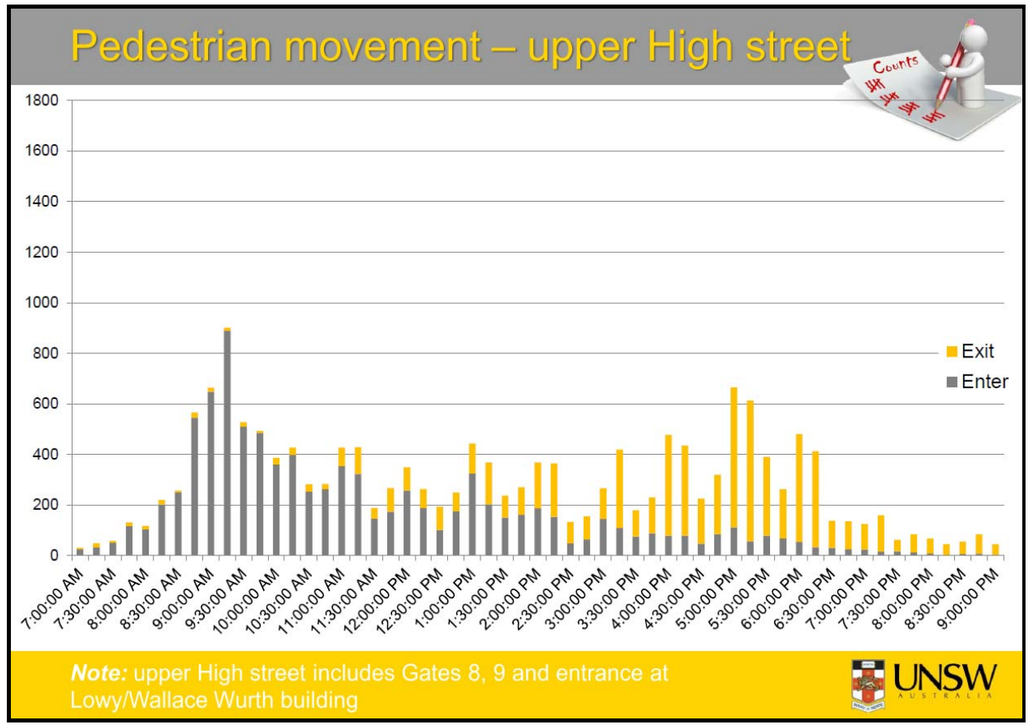
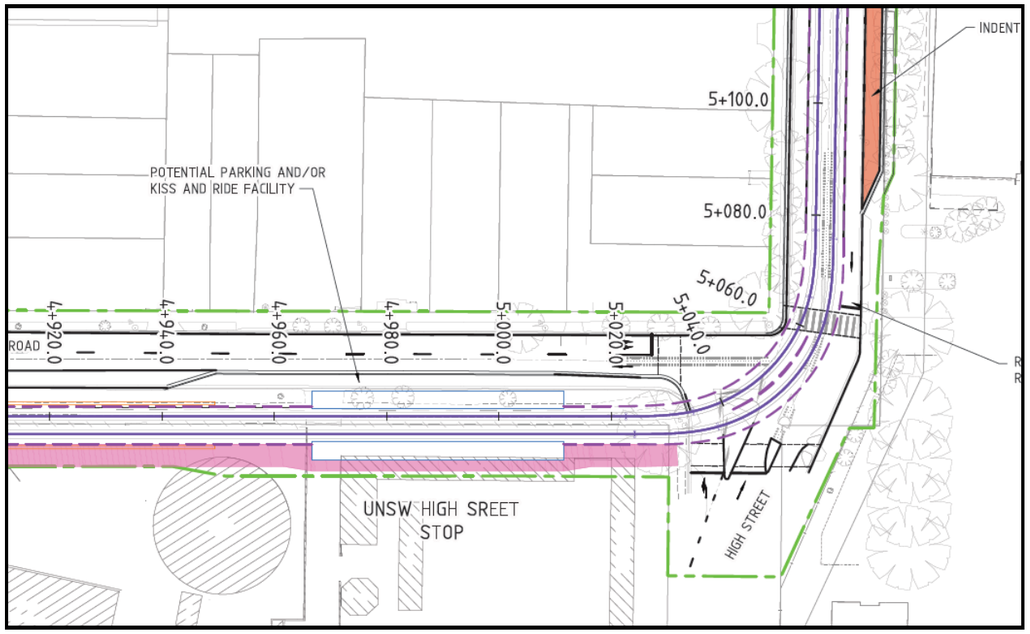



Figure 8: UNSW Pedestrian Movements – 15 minute intervals

## 7.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 9):

- new light rail tracks on the north and east legs of the intersection.
- tram platform stops on the north leg.
- traffic signals.



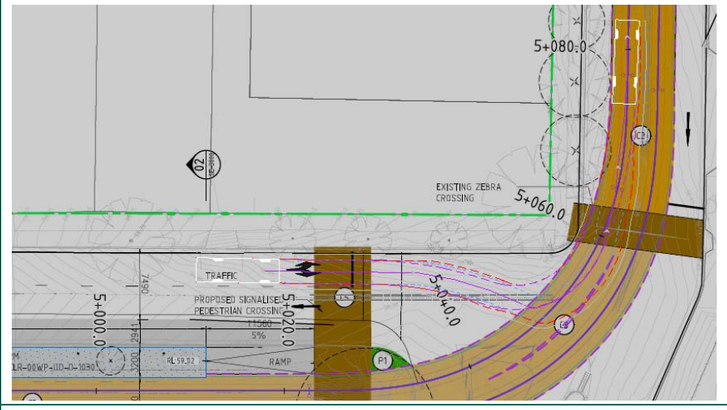

Source: Transport for NSW -

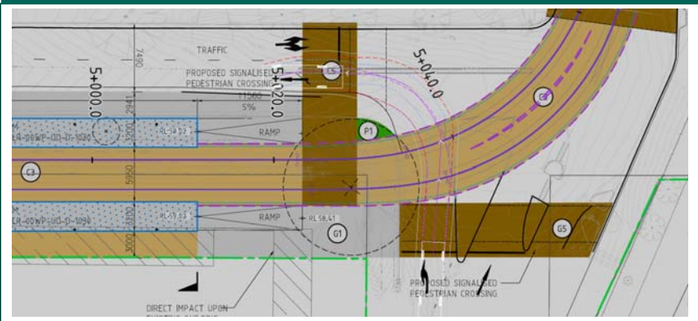
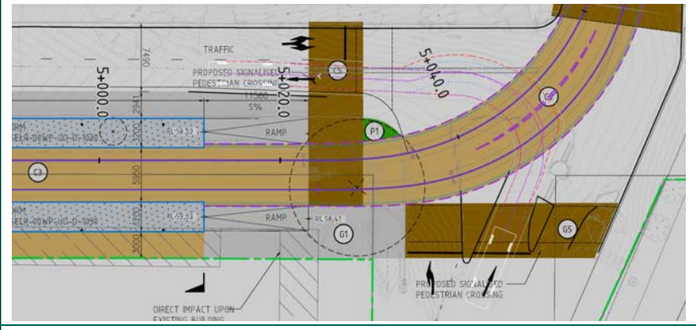
Figure 9: Proposed Conditions - Wansey Road / High Street

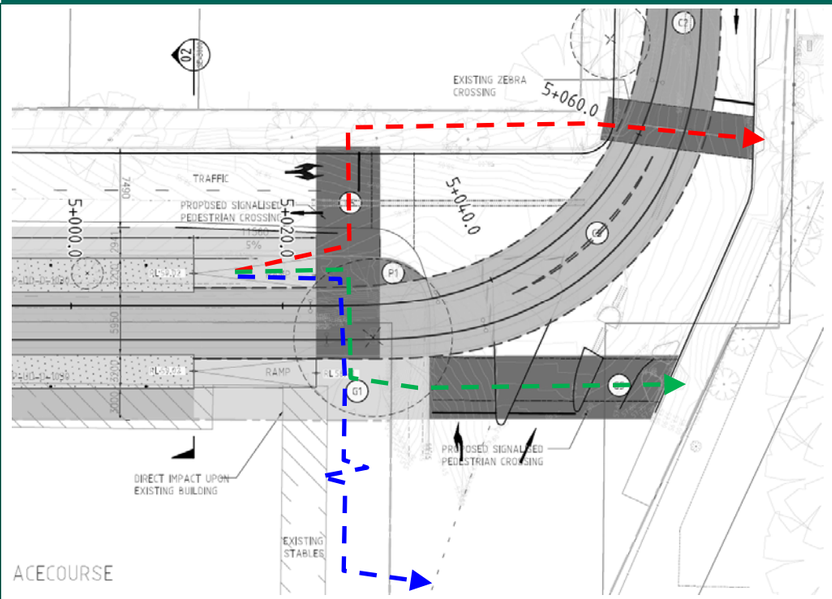
## 7.3 TECHNICAL REVIEW

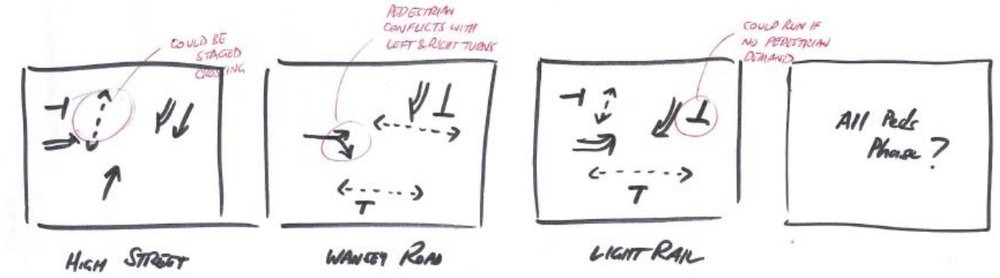
The findings from the review of this location are included in Table 2.

Table 2: Wansey Road / High Street

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| Consistency | - | - | The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. It has been assumed that the Stop Plans are the basis for comment. | Update plans to be consistent. |
| Location | Surrounding Land Uses | Located at north east corner of UNSW campus, on north side of High Street. | Proposed stop is located adjacent to UNSW campus, a major passenger generator. | Nil – not enough room in High Street to locate tracks, stops and traffic lanes. |
| | Land Acquisition | Required from Randwick Racecourse on west side of Wansey Road. | Nil. | Nil. |
| Layout | Track Location | Tracks located on west side of Wansey Rd and centre of High Street. | Track curves require tracks to be located on west side of Wansey Road. Additional land acquisition would be required from residential properties on north east corner of intersection to realign track curves. | Nil. |
| | Platform Size | Both platforms 45.0m x 3.2m = 144.0 sqm. | Assumption: LRV at 2-3 minute frequencies at CBD end will result in LRV at 4-6 minute frequencies at this location. Assume approximately 3 LRV each 15 minute period.<br>Alighting:<br>Assuming a capacity of 300 pax per LRV, should be no more than 300 pax alighting at any one time. Capacity of platforms to cater for peak alighting numbers (approx. 632 pax in 15 minute period).<br>Using the Fruin Level of Service criteria, the ramp (average flow rate of 42 pax per minute) is expected to operate with a Level of Service of A. However, if 211 pax alighted from one LRV, the Level of Service would drop to E.<br>Boarding:<br>Capacity of platforms to cater for peak boarding numbers (approx. 480 pax in 15 minute period).<br>Using the Fruin Level of Service criteria, this platform is expected to operate with a Level of Service of D (129 pax waiting for LRV).<br>The ramp (average flow rate of 26 pax per minute) is expected to operate with a Level of Service of A. However, the signalised crossings will meter the flows of pedestrians. | Alighting:<br>Proposed outbound platform ramp will restrict flow off the stop and will 'meter' pedestrians reaching the crossing points. However, predicted flow rates are expected to be within capacity.<br>Boarding:<br>Proposed citybound platform will be very congested (Level of Service F) with some pax being required to wait on ramp and approaches. |
| | Storage | Ramps provided at both north and south ends to provide access. | Ramps and approaches will provide additional storage if stops are congested. Road safety risk is if pax cannot clear light rail tracks or roads. As the citybound stop will have the highest boarding numbers, the ramp and large storage area is expected to accommodate all required pax without queuing across the light rail tracks and roads. | Nil. |
| | Swept Paths | The proposed tracks and stops will reduce the width of Wansey Road and High Street. | North to east left turns (from Wansey in to High) – very tight radius, turning vehicles may encroach on to citybound light rail tracks.<br>  | Ensure design vehicles able to undertake turn. If cannot undertake turn, stop line on east leg of intersection may need to be set back. |
| | | | West to north left turns (from High in to Wansey) – very tight radius, turning vehicles may encroach on to southbound traffic lane or mount footpath, potential conflict with pedestrians if right turners allowed turn at same time as pedestrians. | Ensure design vehicles able to undertake turn. If cannot undertake turn, consider removal of the left turn slip lane and allow left turns from the eastbound 'through' lane. The left |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | |   | turn slip lane could then be used as a larger pedestrian area and reduce the width of the crossing across the west leg of the intersection. The Wansey Road stop line could then also be moved further south. |
| | | | North to east right turns (from Wansey in to High) – very tight radius, turning vehicles may encroach on to waiting areas, may impact on parking along High Street, potential conflict with pedestrians if right turners allowed turn at same time as pedestrians. | Ensure design vehicles able to undertake turn. Review conflict with pedestrians – consider early start for pedestrians on crossing. |
| | | | LRV clearances increase around tight radii. Turning LRV may encroach in to pedestrian crosswalks and waiting areas. | Ensure adequate clearances to turning LRV around curves and modify crosswalks and waiting areas to suit. |
| | | | Westbound through movements have poor delineation through intersection. | Build out southern side of High Street out to existing kerb outstand. |
| Access | Crossing Points | The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings.<br>Signalised Pedestrian Crossings are proposed at Wansey Rd/High St intersection, across Light rail tracks (at north and south ends) and also across Wansey Rd at north end of stops. | A key design consideration must be the movement of pedestrians to and from the stops. In the AM Peak, there will be a very high movement of pedestrians from the southbound platform, down the ramp, and then across the roads at the signalised access points. Even though these movements are to be controlled by signals, it is expected that pedestrians will cross the tracks and roads against the signals. Therefore, although signalised crossings are required for the road crossings, the crossings of the tracks should be 'LRV priority crossings' which will allow pedestrians to cross as required except for when LRV are present.<br>As the stops are located on the north side of High Street, pedestrians to UNSW will be required to either:<br>▪ cross Wansey Road and High Street,<br>▪ cross tracks then High Street, or<br>▪ cross tracks, walk westbound along High Street then cross at zebra crossing. | Agree that road crossings should be signalised.<br>Recommend that crossings of the tracks should be unsignalised with priority given to LRV. Electronic signs could be used to provide increased warning of an approaching LRV e.g. 'GIVE WAY TO LIGHT RAIL VEHICLE'<br>The removal of the left turn slip lane could increase the storage areas for pedestrians and reduce the crossing width.<br>The southbound shared path ends just north of High Street. Shared path users will need to share this space with large numbers of pedestrians. Provide a surface treatment that clearly delineates the end of the shared path and warns of pedestrians.<br>Consider an alternative access down northern side of High Street to a new pedestrian overpass to provide direct connection in to UNSW campus. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | |  <br>It is noted that the existing zebra crossing on High Street to the west of the Wansey Road intersection(as shown in Figure 6) is used by a large number of pedestrians (mostly bus passengers) and UNSW has safety concerns regarding its operation. Adjacent to this zebra crossing is a raised walkway into UNSW's grounds. A potential future option is to create a pedestrian overpass (to replace the zebra crossing) that connects directly to the raised walkway within UNSW. This option would mean that a significant number of LRV pax would only have to cross the tracks and no roads. | |
| | Ramps | DDA compliant ramps provided at both north and south ends to provide access. | The ramps end at the crossing points which may create congestion as pedestrians wait to cross the tracks or Wansey Rd. | Shorten ramps if possible to create larger waiting areas prior to cross points. |
| | Illegal Access | No fencing has been shown. | The crossing at northern end important to provide access to from residential area and park and ride.<br>Illegal or undesirable crossings are expected to occur between the shared path, track and park and ride footpath (especially during the AM Peak). | Install fence between shared path and tracks (to protect shared path uses from opposing LRV), and between park and ride footpath and tracks (to prevent pedestrians crossing tracks away from formal crossing points. |
| | Safety | - | Illegal access is the main safety issue as discussed above. | Nil. |
| | Footpath / Shared Path | 4.0m shared path on Wansey Road narrows to 3.0m past platform. | Shared path ends at southern end of platform. Shared path users, especially cyclists, will enter an area with significant numbers of pedestrians. | Nil – 3.0m is desirable width for shared path.<br>Ensure path material and signage indicate end of shared path.<br>Consider installation of bicycle lanterns for crossing of High Street to allow cyclists to cross without dismounting. |
| | Vehicle | - | University access restricted to left in/left out. | Nil. |
| Intermodal | Sharing of Tracks | - | n/a | n/a |
| | Bus Stops | Westbound bus stops (indented bays) proposed on south side of High Street east of intersection. | Proposed stop will replace a number of existing bus stops in High Street. | Nil. |
| | | Eastbound bus stops retained on north side of High Street west of intersection. | Nil. | Nil. |
| | Bus / LRV Transfer | - | It is noted that some bus stops will be retained, and passengers may transfer to LRV. These passengers likely to cross High Street then Wansey Road. | Nil. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | Bus Priority | No bus priority shown on plans. | LRV and pedestrian priority likely to be highest priorities, so unlikely to be able to also provide bus priority. In addition, buses will not be located in separate lanes so additional priority unlikely to be effective. | Nil. |
| Signal Operation | Overview | No details provided. | Separate phases likely to be required for High Street throughs, Wansey Road left/right, and tram movements. Some other movements (vehicle and pedestrian) could run with LRV phases. Some traffic movements conflict with pedestrian movements.<br>  | Review phasing to determine optimal operation for LRV and pedestrians. |
| | LRV Movements | | Signalised left and right turn movements. LRV movements could run separately. May not want green for pedestrians across Wansey Road at same time as LRV movements as pedestrians may observe green walk signal and think it applies to the crossing of the tracks.<br>Need to determine southbound trams 'trigger' signals. The time at stops is variable and only want to provide time to LRV phases when needed. Providing advance detection of east leg will be possible. Advance detection on north leg not possible due to proximity of stop. So when LRV detected, need to be able to 'close' down other phases as quickly as possible. The restriction on closing down phases will be pedestrian crossing clearance times. If pedestrian crossing can be as short as possible, this reduces the time required to 'stop' the pedestrian phase and switch to the LRV phase. | If crossing of Wansey Road is signalised and crossing of tracks is not, stagger the crossings so that pedestrians are required to change direction.<br>Modify intersection to increase distance between light rail stop and crossing point to allow detection of southbound LRV.<br>Modify intersection to reduce length of the pedestrian crossings.<br>Signal operation should be set up to allow LRV phase to run between other phases to reduce delays. |
| | Bus Movements | Bus movements eastbound and westbound through intersection. | No additional priority. | Nil. |
| | Pedestrian Movements | Pedestrian Operated Signals and LRV Priority Crossings. | Some traffic and tram movements conflict, need to consider how they will be undertaken safely. One option may be to run an all pedestrian phase which allows pedestrians to cross in all directions at one time. | Consider an all pedestrian phase which allows pedestrians to cross in all directions at one time. |
| | Traffic Impacts | Right turn movement from east to north removed. | Northbound (left turn) and eastbound (through) traffic will share High Street with LRV. Although light rail tracks are separated midblock, right turning vehicles share the tracks. | Consider some form of traffic metering, especially in High Street east of intersection, to hold traffic in Wansey and/or High to reduce congestion for eastbound LRV. Note this may impact on High Street bus services. |

# 8 ANZAC PARADE UNSW STOP (UNSW)

The proposed Anzac Parade stop will service the lower campus of UNSW.

## 8.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 10 and Figure 11 are summarised as follows:

- Three traffic lanes in each direction, central median with pedestrian fence. Kerbside lane is a bus lane in peak periods in peak direction and parking lane at other times.
- Pedestrian facilities – Pedestrian Operated Signals.
- Bus routes along High Street. Bus stops located to the north (northbound) and south (southbound) of the POS.
- Pedestrian access to UNSW's lower campus and NIDA campus.

Source: http://maps.six.nsw.gov.au/

Figure 10: Anzac Parade (UNSW) – Existing Conditions

View West to Anzac Parade

View West across Anzac Parade

View North along Anzac Parade

View South along Anzac Parade

View North along Anzac Parade

View South along Anzac Parade

Figure 11: Anzac Parade (UNSW) – Photographs

Daily pedestrian movements (by location and mode at each of the main access points) was provided by UNSW and are presented in Figure 12: UNSW Daily Pedestrian Movements - by location by mode. This shows the high number of arrivals (17,662) from the existing bus stops in Anzac Parade and High Street, with approximately 74% (13,100) by public transport. There is also a high number of departures (20,049) to the existing bus stops in Anzac Parade and High Street, with approximately 76% (15,300) by public transport.

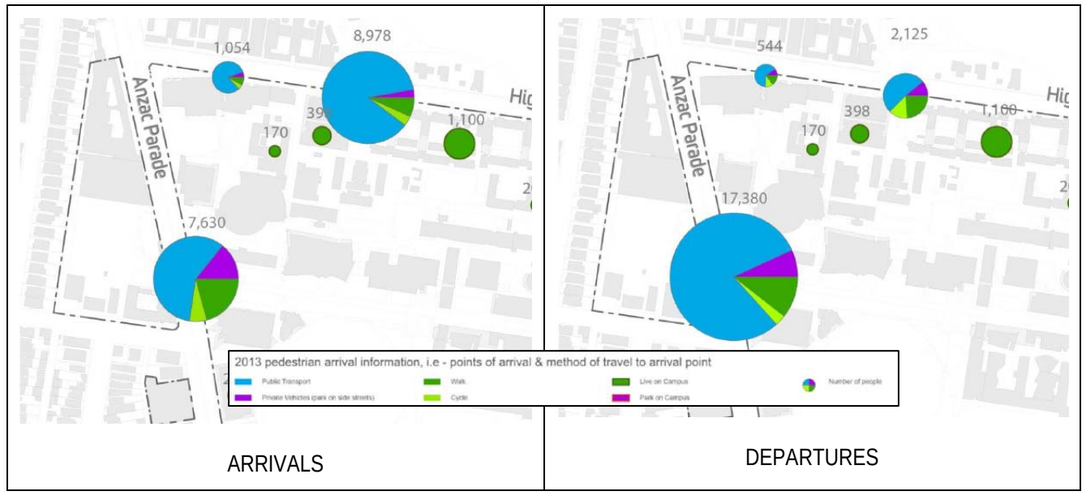



Figure 12: UNSW Daily Pedestrian Movements - by location by mode

Figure 13 presents the breakdown of pedestrian movements in 15 minute intervals.

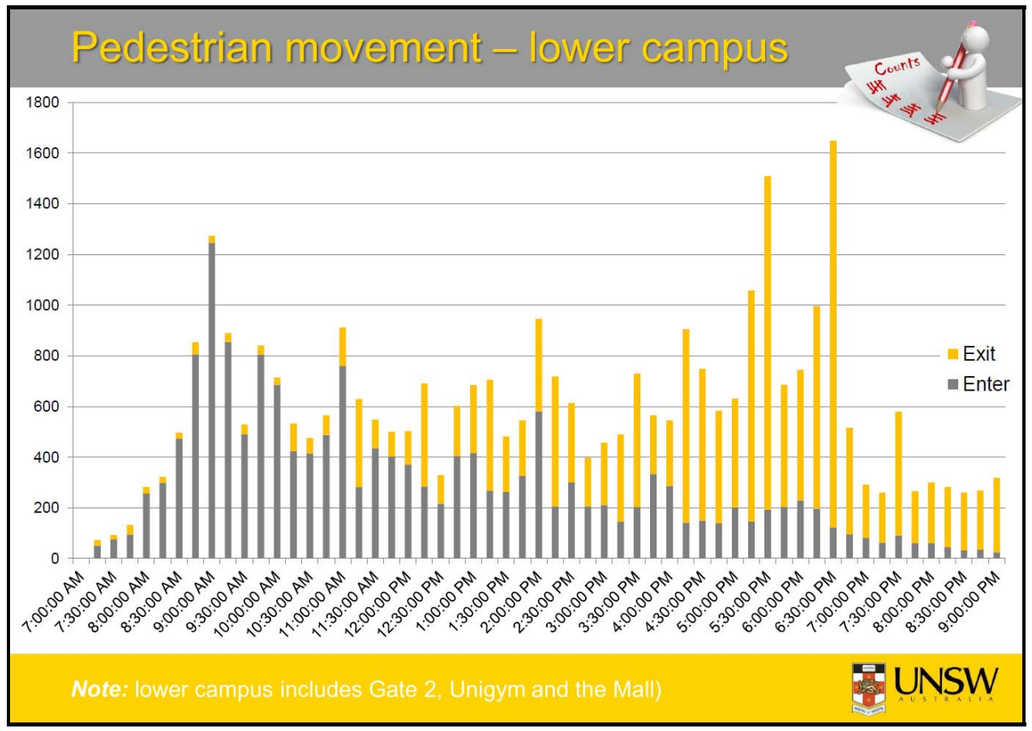
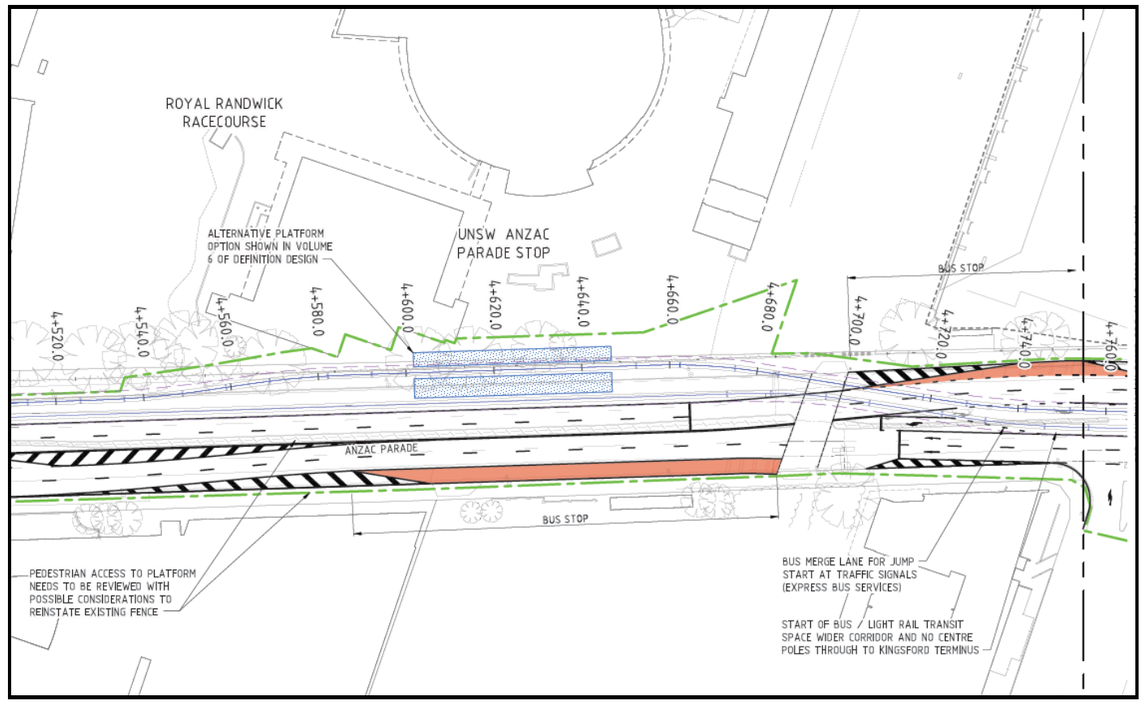



Figure 13: UNSW Pedestrian Movements – 15 minute intervals

## 8.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 14):

- new light rail tracks on the east side of Anzac Parade.
- island platform (northbound LRV) and side platform (southbound LRV).
- retention of existing northbound bus stop on west side of Anzac Parade.
- Pedestrian Operated Signals modified to control movements of LRV, buses and traffic moving across lanes.




Source: Transport for NSW

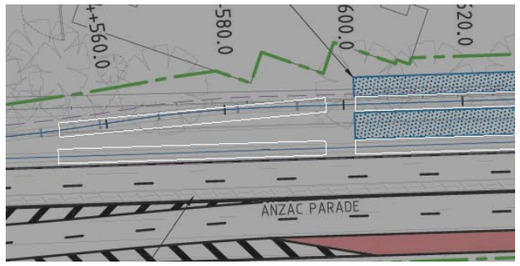
Figure 14: Anzac Parade (UNSW) – Proposed Conditions

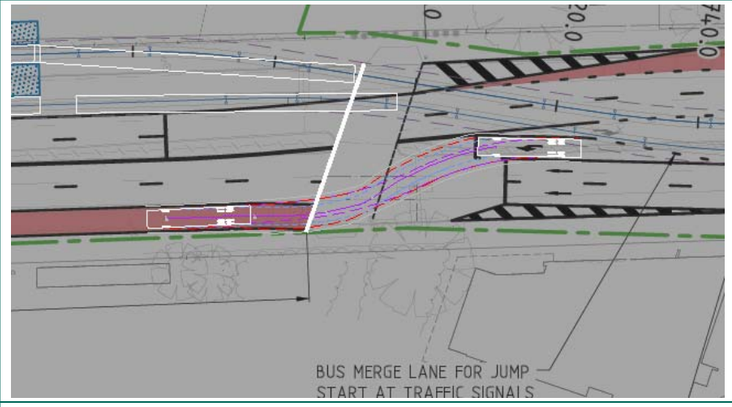
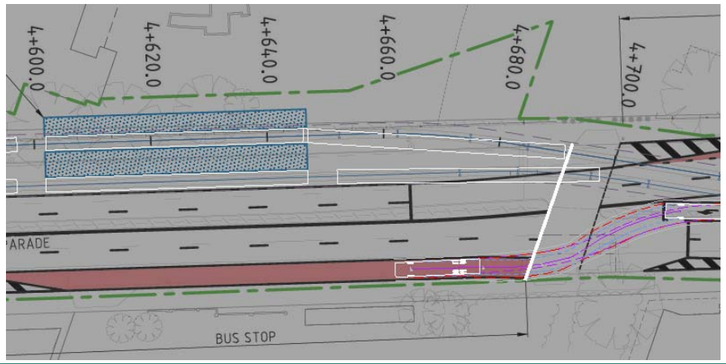
## 8.3 ISSUES / OPPORTUNITIES

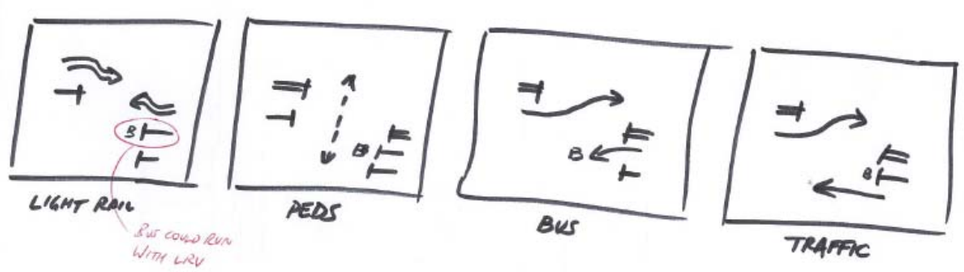
The findings from the review of this location are included in Table 3.

Table 3: Anzac Parade (UNSW)

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| Consistency | - | - | The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. It has been assumed that the Stop Plans are the basis for comment. | Update plans to be consistent. |
| Location | Surrounding Land Uses | Proposed stop located adjacent to UNSW campus and close to University Mall. | Location adjacent to University Mall is a good location close to a major attractor.<br>However, need to consider what is more important to be located at the western end of University Mall. LRV stops likely to be used by significantly more pedestrians than the POS. | Nil. |
| | Land Acquisition | Land acquisition required from UNSW, impacts on Square House Building to be confirmed. | Moving stops further south could reduce that impact. | Nil. |
| Layout | Track Location | Tracks change from centre of road to east side at High Street signalised intersection and change back to centre of road at University Mall Pedestrian Operated Signals. | Light rail tracks changing from centre of Anzac Parade to east side and back will create additional delays to LRV. For example, along Harbour Esplanade in Melbourne, two years ago trams were changed from crossing to and from the centre of the road to travelling down the middle of the road over a 500m length. This was done to reduce delays to trams, and to provide a clearer separation between trams, pedestrians and cyclists. Previously, trams, pedestrians and cyclists used to share a wide, undefined plaza.<br>The light rail tracks changing from centre of Anzac Parade to east side and back will create additional delays to light rail vehicles, buses and other traffic along Anzac Parade. In addition, the changing of the tracks creates a very complex intersection at the Pedestrian Operated Signals at University Mall, with LRV movements, bus movements, traffic movements and pedestrian movements.<br>Southbound traffic must undertake a lateral shift across diagonal light rail tracks with no physical separation from northbound LRV and buses. This arrangement may create confusion for drivers and wet light rail tracks are slippery. The stop line will be set back approximately 20m from the Pedestrian Operated Signals and the plans show no delineation (lane lines) through this area to direct southbound traffic.<br>It is understood that 'the UNSW Anzac Parade stop is proposed in an offline location which will minimise interaction between cars and pedestrians on the eastern side of Anzac Parade. This enables customers alighting at the stop to directly access the University Mall without having to cross Anzac Parade.' | Retain light rail tracks in centre of road and construct a wide centre island platform, with access from the University Mall Pedestrian Operated Signals. This will reduce delays to LRV, traffic and buses, locate the stop adjacent to University Mall, and simplify the intersection at the Pedestrian Operated Signals. Land acquisition could still be used to facilitate the wider platform stop.<br>The main trade-off for this arrangement is that the majority of passengers would need to cross one LRV track and two southbound traffic lanes. This has a higher safety risk than the proposed arrangement of that requires a crossing of one LRV track only.<br>Also need to consider pedestrians using the Pedestrian Operated Signals. When northbound traffic stops, pedestrians may think they can walk, but it may be for LRV or buses.<br>*NB: The following sections review the proposed light rail tracks on the eastern side of Anzac Parade. The above alternative is provided for consideration and discussion.*<br>Traffic islands could be created within the centre of the two directions of traffic (subject to the swept path of the northbound bus) to direct southbound traffic across the tracks away from northbound LRV and buses. An island between the northbound traffic lanes and the northbound bus lane would be beneficial to physically separate these lanes. |
| | Platform Size | Side platform 45.0m x 3.2m = 144.0 sqm.<br>Island platform 45.0m x 4.4m = 198.0 sqm.<br>The report indicates the need to make provision for future lengthening of stops, but there is not sufficient room at the northern end. | Assumption: LRV at 2-3 minute frequencies at CBD end will result in LRV at 4-6 minute frequencies at this location. Assume approximately 3 LRV each 15 minute period.<br>Alighting:<br>Assuming a capacity of 300 pax per LRV, should be no more than 300 pax alighting at any one time. Capacity of platforms to cater for peak alighting numbers (approx. 898 pax in 15 minute period).<br>Using the Fruin Level of Service criteria, the ramp (average flow rate of 60 pax per minute) is expected to operate with a Level of Service of A. However, if 299 pax alighted from one LRV, the Level of Service would drop to E.<br>Boarding:<br>Capacity of platforms to cater for peak boarding numbers (approx. 1,143 pax in 15 minute period).<br>Using the Fruin Level of Service criteria, this platform is expected to operate with a Level of Service of E (381 pax | Alighting:<br>Proposed southbound platform ramp will lead directly to footpath and will not restrict flow off the stop (subject to proposed fencing arrangements to separate stop from shared path). Congestion may encourage some passengers to use northern pedestrian access.<br>Boarding:<br>Proposed citybound platform will be very congested (Level of Service E/F) with some pax being required to wait on ramp and approaches. The short ramp and limited storage area on the crossing may prevent all passengers being able to access the platform stop at peak times. This will prevent |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | | waiting for LRV).<br>The ramp (average flow rate of 76 pax per minute) is expected to operate with a Level of Service of E.<br>One example of a large centre island platform stop in Melbourne is the Melbourne University stop. This is approximately 6.5m wide and 60m long with ramps and signalised pedestrian crossings at both ends.<br>  | safe passenger circulation along the stop.<br>Design track layouts to provide for future lengthening of citybound stop.<br>  |
| | Storage | Ramps provided at both north and south ends to provide access. | The short ramp and limited storage area on the crossing to the citybound stop may prevent all passengers being able to access the platform stop at peak times. This will prevent safe passenger circulation along the stop. | Review size of platform stop and length of ramp to cater for peak passenger loads. |
| | Swept Paths | Nil. | LRV and buses will create wider swept paths as they undertaken turns to and from the centre of the road. | Review swept paths of turning LRV and buses. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | |  | |
| | LRV | LRV Priority crossings at both ends of stops. University Mall Pedestrian Operated Signals located approximately 30m south of southern stop crossing.<br>NB: Stop line for Pedestrian Operated Signals should be located 6m back from crosswalk. | Southbound LRV will need to 'trigger' LRV phase to cross back to centre of road. There is not enough length between stop and Pedestrian Operated Signals for LRV to store without blocking southern crossing.<br>A second northbound LRV could follow another LRV through the Pedestrian Operated Signals as there is just enough room for it to store clear of the Pedestrian Operated Signals. However, the second northbound LRV would reduce visibility to pedestrians using the Pedestrian Operated Signals.<br>  | Review how southbound LRV will 'trigger' tram phase.<br>Review storage of southbound LRV between stop and POS.<br>Review storage of northbound LRV between stop and POS. |
| | Signal Pedestals | There is no room between either the two directions of traffic or between the southbound traffic lanes and the northbound light rail tracks. | There is no room available for signal pedestals to be located next to the southbound traffic. Large mast arms will be required. The height and location of the large mast arms will need to consider the overhead light rail wires.<br>The complex movements required at the intersection of the Pedestrian Operated Signals would also benefit from adjacent signal pedestals. However, large mast arms are likely to be required. | Review layout to create space for signal pedestals |
| | Crossing Points | LRV priority crossings are shown at the north and south ends of the stops. | As shown on the Stop Plan, the crossings do not need to extend on to the northern Light rail tracks.<br>Access at the northern end is important if land use within UNSW changes and provides an alternative access/egress to the stop during peak times.<br>LRV Priority Pedestrian Crossings are proposed. In Melbourne, the signs used in these instances are 'Give Way to Trams'. With the high number of pedestrians and complex movements for the LRV, static signs may not be enough. Could consider supplementary LRV-activated LED signs to warn of approaching LRV.<br>Important to used different materials to indicate LRV areas and pedestrian waiting areas. | Remove crossings across northbound tracks. Install a fence along the east side of the northbound tracks. |
| | Ramps | DDA compliant ramps provided at both north and south ends to provide access. | The ramp ends at the crossing points which may create congestion as pedestrians wait to cross the southbound track. | Shorten ramps if possible to create larger waiting areas. |
| Access | Illegal Access | No pedestrian fencing shown. | Existing pedestrian fence is located in the centre median adjacent to the Pedestrian Operated Signals. Illegal pedestrian movements to and from the platform stops is likely. | Consider the installation of pedestrian fencing adjacent to the citybound LRV track. |
| | Safety | - | Illegal access is the main safety issue as discussed above. | Nil. |
| | Footpath / Shared Path | Wide footpath to be provided along east side of tracks. | Footpath along east side of Anzac Parade used as a bicycle route. | Consider barrier along outside of side platform to prevent people from just walking out on to shared path and creating |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | | | pedestrian/cyclist conflict. |
| | Vehicle | - | n/a | n/a |
| | Sharing of Tracks | Buses to share LRV track south of this location. | Bus movements out of LRV corridor provided through a jump start lane. There is no separation between the bus lane and the adjacent traffic lanes. It is desirable to create an island between the bus lane and the adjacent traffic lanes to ensure drivers do not move off when the bus moves off (as the bus needs to cut in front of the traffic). A bus storing in this lane may be unable to store clear of the light rail tracks and may block the tracks.<br>It is unclear how southbound buses get on to light rail tracks. | Review layout of bus jump start lane to create separation between bus lane and adjacent traffic lanes.<br>Review how southbound buses get on to light rail tracks. |
| | Bus Stops | Existing northbound bus stops (80m) retained. Provision for one southbound bus stop (15m). | Nil. | Nil. |
| Intermodal | Bus / LRV Transfer | - | Adjacent bus stops are expected to be for local bus routes.<br>Unlikely to be high number of transfers. | Nil. |
| | Bus Priority | - | As above. | Nil. |
| Signal Operation | Overview | Complex intersection at Pedestrian Operated Signals to cater for all movements. | Multiple phases will be required – LRV phase, pedestrian phase, northbound bus phase (which could run with tram phase or SB traffic) and a traffic phase.<br>A road safety risk is that when pedestrians see traffic come to a stop (particularly those pedestrians on the west side of Anzac Parade), they may assume that the pedestrian phase may run next. However, the bus or LRV phases may run and create a conflict with pedestrians.<br>  | Review the potential phasing arrangement to minimise conflicts. |
| | LRV Movements | LRV to cross to and from centre of Anzac Parade, through Pedestrian Operated Signals. | As outlined above, LRV will be delayed moving to and from the centre of the road and the storage of LRV whilst waiting to move through intersection may block crossings. | Nil. |
| | Bus Movements | Buses to share LRV track south of this location. | Citybound buses waiting to merge across could delay LRV, run bus clearance phase at same time as LRV phase.<br>Ideally would be some separation between citybound bus and northbound vehicles. | Review layout to create separation between northbound buses and northbound traffic. |
| | Pedestrian Movements | Pedestrian Operated Signals crossing approximately 23m wide across Anzac Parade. | If a LRV or bus is detected, the pedestrian phase will take the longest to 'close down' (to ensure adequate clearance time for pedestrians to complete their crossing). | Consider PUFFIN at Pedestrian Operated Signals. |
| | Traffic Impacts | Complex intersections at High Street and University Mall will increase delays to other traffic. | No right turn proposed in to Day Avenue. It is understood that this is a key local route through this area and more suitable than Barker Street. Keeping tracks on east side of Anzac Parade may permit right turn into Day Avenue to be retained. | Review layout of University Mall Pedestrian Operated Signals and Day Avenue traffic movements. |

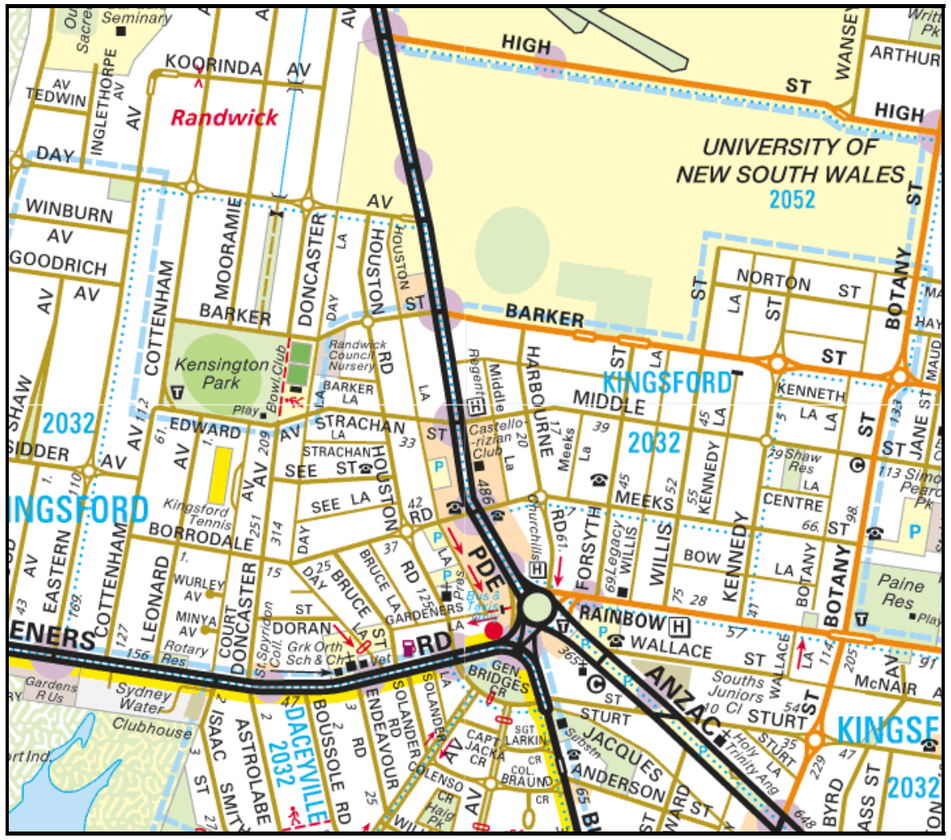
# 9 ANZAC PARADE – UNSW TO NINEWAYS (COUNCIL)

The proposed works on Anzac Parade between the UNSW stop and Nineways intersection service the commercial and residential area along Anzac Parade.

## 9.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 15 and Figure 16 are summarised as follows:

- Two traffic lanes in each direction, central median with pedestrian fence. Kerbside lane is a bus lane in peak periods in peak direction and parking lane at other times.
- Signalised cross intersections at Barker Street, Strachan Street / Middle Street, Borrodale Road / Meeks Street.
- Unsignalised intersections at Day Avenue (T-intersection) and Nineways (roundabout).
- Pedestrian Operated Signals located between Borrodale Road / Meeks Street and Nineways roundabout.
- Bus routes along Anzac Parade.
- Commercial and high density residential along route.




Source: Melways Publishing

Figure 15: Anzac Parade (UNSW to Nineways) – Existing Conditions

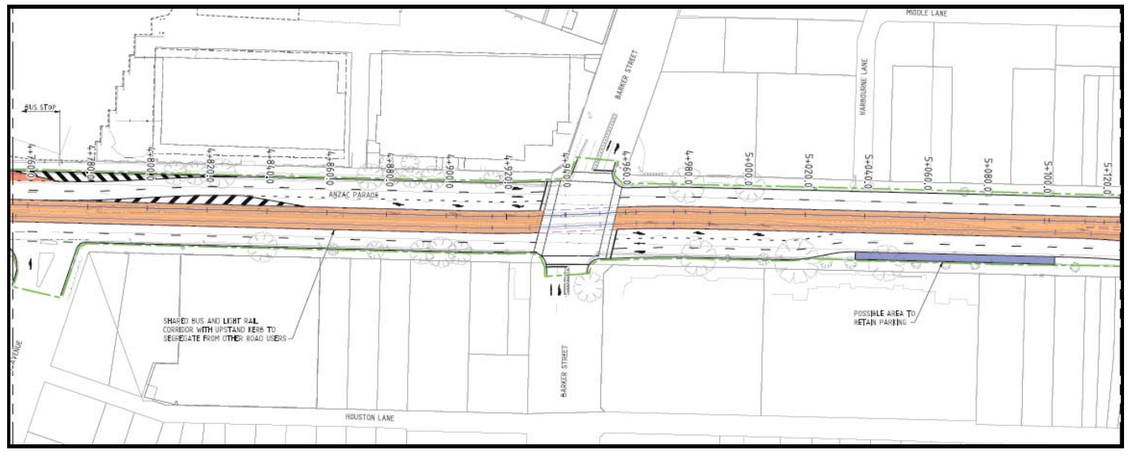
| | |
|---|---|
|  View South along Anzac Parade (to Day Ave) |  View South along Anzac Parade (to Barker St) |
|  View South along Anzac Parade (to Strachan St) |  View South along Anzac Parade (to Meeks St) |
|  View South along Anzac Parade (to Nineways) |  View North along Anzac Parade (to Nineways) |

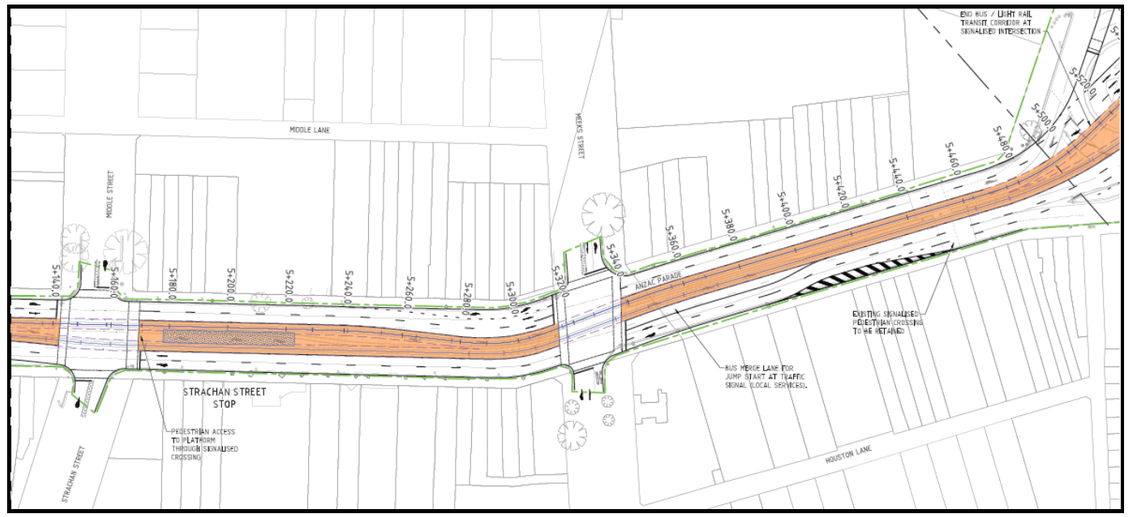
Figure 16: Anzac Parade (UNSW to Nineways) – Photographs

## 9.2 PROPOSED CONDITIONS

It is proposed to construct (as shown in Figure 17 and Figure 18):

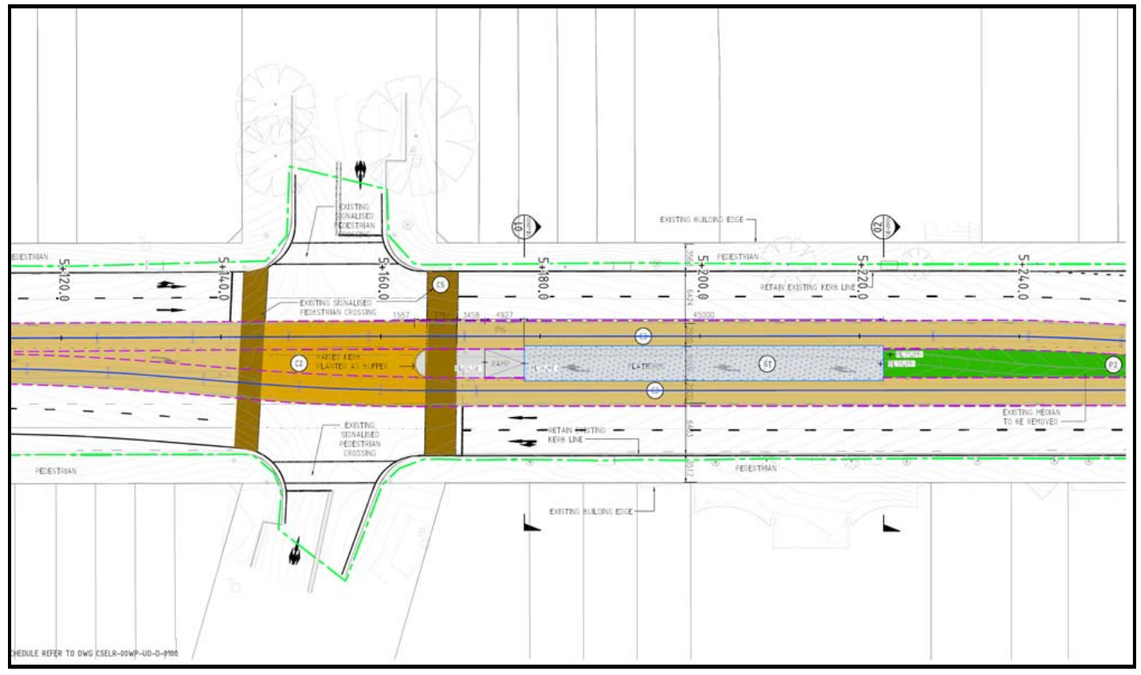
- Light rail tracks in centre median (with express buses to use tracks).
- Island platform at Strachan Street / Middle Street.
- Retention of two traffic lanes in each direction and removal of bus lane and parking lane (in most locations).




Source: Transport of NSW

Figure 17: Anzac Parade (UNSW to Nineways) – Proposed Conditions




Source: Transport of NSW

Figure 18: Anzac Parade / Strachan Street – Proposed Conditions

## 9.3 ISSUES / OPPORTUNITIES

The findings from the review of this location are included in Table 5.

Table 4: Anzac Parade (UNSW to Nineways)

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| Consistency | - | - | The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. It has been assumed that the Stop Plans are the basis for comment. | Update plans to be consistent. |
| Location | Surrounding Land Uses | Strachan Street stop located in centre of Kingsford commercial area. Located approximately 500m from other stops. | Large spacing between stops may increase illegal crossings to and from the southern end of the Strachan Street stop. | Nil. |
| | Land Acquisition | - | n/a | Nil. |
| Layout | Track Location | Tracks located in centre of road, traffic island to separate tracks from traffic lanes. | Nil. | Nil. |
| | Platform Size | Island platform 45.0m x 4.2m = 189 sqm. | Precinct Access Plan (Table 7-17) states:<br>802 boardings & 84 alightings forecast for 2021 (total – 886).<br>1024 boardings & 99 alightings forecast for 2036 (total – 1,123).<br>Platform stops easily able to accommodate pax numbers. | Nil. |
| | Storage | Storage area provided adjacent to signalised crosswalk. | Storage at signalised crosswalk is critical. Pedestrians will need to go both directions. Need space for a signal pedestal to locate push button/s. | Provide push button at northern end of stop. |
| | Swept Paths | Tracks slew across Barker Street intersection to create right turn lanes. | Slewing of tracks across Barker Street reduces width of traffic lanes. Traffic lane stop lines may need to be set back to accommodate the swept paths of LRV. | Review impacts of LRV swept paths on traffic lanes. |
| | LRV | - | LRV at Strachan Street likely to get majority of green time at intersection. Side road phase unlikely to be able to be cut short due to time required for pedestrian crossings. Staging of pedestrian crossings not desirable as it reduces level of service for pedestrians, there are not suitable storage areas and increases illegal pedestrian movements.<br>Need to determine how northbound LRV at Strachan stop can trigger LRV priority phases. | Review advance detection for northbound LRV. |
| | Signal Pedestals | There is no room at the Barker Street intersection to install traffic signal pedestals between the traffic lanes and the light rail tracks. | There is no room available for signal pedestals to be located between the traffic lanes and the light trail tracks. Large mast arms will be required. The height and location of the large mast arms will need to consider the overhead light rail wires. | Review how signal control will be provided. |
| | Traffic Lanes | Two lanes in each direction. Right turn lanes at Barker Street (both directions). Left turn lane at Meeks Street (southbound only). | General:<br>Right turns at Barker Street (both directions) will need to be fully controlled (red arrows) to give priority to LRV and buses.<br>Currently, left turn movements occur in the bus / parking lane. These movements will now occur in the shared left / through traffic lane and will reduce the traffic capacity along Anzac Parade. There is an increased road safety risk of rear end crashes than existing conditions.<br>Southbound:<br>Need to ensure right turn lanes have sufficient capacity to store vehicles. NB: No information provided to review.<br>At Meeks Street, consider removal of left turn lane to allow provision of an island to install traffic signal pedestals and/or increase the radius of the light rail tracks across the curve to the north of the intersection, and reduce the slewing of the tracks across the intersection.<br>Northbound:<br>The taper at the end of the parking lane immediately south of Barker Street is too short. A taper of increased length with either shorten the right turn lane or reduce the length of the parking lane.<br>It is proposed to reduce the number of lanes from 3 to 2 immediately north of the existing Pedestrian Operated Signals just north of Nineways. The proposed taper is very short, and it is not appropriate to end the third lane | Review layout of traffic lanes. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | | immediately after the Pedestrian Operated Signals. | |
| | Parking Lanes | Northbound parking lane between Strachan Street and Barker Street. | As outlined above, a taper of increased length with either shorten the right turn lane or reduce the length of the parking lane. | Review layout of parking lane. |
| Access | Crossing Points | Strachan Street stop has a signalised crosswalk at the northern end.<br>All other intersections maintain existing crosswalks. | Nil. | Nil. |
| | Ramps | Ramp provided at northern end of Strachan Street stop. | Nil. | Nil. |
| | Illegal Access | No access provided to southern end of Strachan Street stop. | Although no access is provided at southern end of Strachan Street stop, it is very difficult to prevent illegal access from this end of the stop. The only way to prevent access would be the installation of fencing along both sides of the light rail tracks. | Consider installation of landscaping to discourage use of the southern end of the stop, but it is better that illegal movements occur from the landscaped area rather than walking along the tracks and stepping up on to the stop platforms. |
| | Safety | - | Illegal access is the main safety issue as discussed above. | Nil. |
| | Footpath / Shared Path | - | Nil. | Nil. |
| | Vehicle | Right turns banned at several locations (Day Av, Strachan St, Meeks St). | Turn bans will change traffic patterns through streets adjacent to Anzac Parade. | Nil. |
| Intermodal | Sharing of Tracks | Buses and trams to share tracks in narrow corridor. Some cross section plans show narrow traffic island, other plans show tracks are raised. No separation island is shown between tracks. | Buses may encroach on to opposite track / bus lane.<br>Any traffic islands should be designed to minimise risk of being a trip hazard for pedestrians if midblock crossings across tracks are expected.<br>Any traffic islands should be able to be mounted by emergency service vehicles. Emergency services vehicles use the light rail tracks in Melbourne in particular within the CBD.<br>In Melbourne, cars usually position themselves with their right tyre to the right of the right track or between the two tracks. Driving with both tyres on the tracks creates discomfort and reduces skid resistance in wet conditions. Need to consider where bus tyres will be positioned on the tracks.<br>It is unclear if southbound buses can access the light rail tracks at locations other than the UNSW stop. | Provide narrow 'guide kerb' to ensure buses do not encroach in to opposing direction LRV or buses, especially around tight corners.<br>Consider the lateral position of buses on the light rail tracks when determining width of shared LRV/bus lanes. |
| | Bus Stops | It is understood some of the existing local bus stops in Anzac Parade will be retained. | Local buses still stopping along Anzac Parade will now stop in traffic lane (rather than parking lane or bus lane as before). This will reduce traffic capacity as one lane will be blocked at times.<br>Bus stops on the departure sides of intersection will cause queuing through the intersection.<br>Bus stops on the approach sides of intersections should be set back to allow left turning vehicles to move around the stopped bus, and enable sufficient warning to left turning vehicles as the bus moves off from the stop. | Review the location of retained bus stops, and if required, relocate from the departure site of the intersection. |
| | Bus / LRV Transfer | - | There may be some transfers to/from local buses near Strachan Street. | Consider the location of bus stops near Strachan Street |
| | Bus Priority | Northbound bus jump lane provided at Meeks Street for local buses to get off the light rail tracks. | Bus movements out of LRV corridor provided through a jump start lane. There is no separation between the bus lane and the adjacent traffic lanes. It is desirable to create an island between the bus lane and the adjacent traffic lanes to ensure drivers do not move off when the bus moves off (as the bus needs to cut in front of the traffic). As discussed above, removal of the southbound left turn lane may create space for a narrow traffic island. | Review layout of bus jump start lane to create separation between bus lane and adjacent traffic lanes. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | |  <br>The removal of the third northbound traffic lane at the existing Pedestrian Operated Signals (as discussed above) could be used to extend the bus jump lane if required. | |
| Signal Operation | Overview | - | Majority of time already given to Anzac Parade, so delays to LRV and buses should be minimal. Side road phase unlikely to be able to be cut short due to time required for crossings. Fully controlled right turns will reduce delays to LRV and buses. Staging of pedestrian crossings not desirable as it reduces level of service for pedestrians, there are not suitable storage areas and increases illegal pedestrian movements. | Nil. |
| | LRV Movements | Need to determine method to detect LRV and buses on tracks. | Priority at Strachan Street for northbound LRV/buses will be difficult due to proximity of stop to intersection, and variable time for boarding / alighting.<br>Advance detection should be able to be provided to extend green time along Anzac Parade at most locations with the exception of northbound approaching Strachan Street (due to the stop). Advance detection is when the LRV is detected passing a particular point upstream of the signals and the signals can be adjusted to provide priority for that vehicle. It works well when there is 'certainty' of travel time. | Review advance detection for north LRV/buses. |
| | Bus Movements | Northbound bus jump lane provided at Meeks Street for local buses to get off the light rail tracks. | Northbound bus jump start at Meeks Street will require separate phase. This will occur either before or after the northbound through traffic phase, and could occur with the tram phase. If this occurs at the end of the through traffic phase, pedestrians crossing Anzac Parade (in particular from the west), may assume that the pedestrian walk phase is about to commence. This may create a risk of conflict between the buses and pedestrians.<br>Need to develop method of detection if more than one bus is waiting. | Review signal phasing at Meeks Street. |
| | Pedestrian Movements | All pedestrian crosswalks maintained at signalised intersections. | PUFFIN signals could be used to reduce delays to LRV / buses at existing Pedestrian Operated Signals.<br>Left turn movements will now be undertaken from the shared left turn / through traffic lane rather than the bus / parking lane. Left turning vehicles will feel 'pressured' to clear the through traffic lane, in particular at peak times. This may increase the road safety risk to pedestrians. Consider the use of pedestrian 'early starts' to allow pedestrians to commence their crossing of the side street prior to Anzac Parade traffic receiving a green signal. | Consider PUFFIN at Pedestrian Operated Signals to reduce delays to LRV / buses.<br>Consider the use of pedestrian 'early starts'. |
| | Traffic Impacts | - | No additional signal issues from a traffic perspective. | Nil. |

# 10 KINGSFORD TRAM STOP & TERMINUS (COUNCIL)

The proposed Kingsford stop and terminus will cater for the high number of bus / LRV transfers. The Nineways roundabout will also be modified significantly and changed to a signalised cross intersection.

## 10.1 EXISTING CONDITIONS

The existing conditions are shown in Figure 19 and Figure 20 are summarised as follows:

- Three traffic lanes southbound and two traffic lanes northbound, with parking on both sides of each carriageway and wide central median with parking.
- Unsignalised intersections at Nineways (roundabout), Wallace Street (T-intersection) and Sturt Street (cross intersection).
- Pedestrian Operated Signals located between Wallace Street and Sturt Street on southbound carriageway (South Juniors).
- Commercial and residential, with South Juniors located adjacent to proposed terminus.

Source: http://maps.six.nsw.gov.au/

Figure 19: Kingsford Terminus – Existing Conditions

View South along Anzac Parade (to Sturt St)

View North along Anzac Parade (from Wallace St)

View North along Anzac Parade (to Nineways)

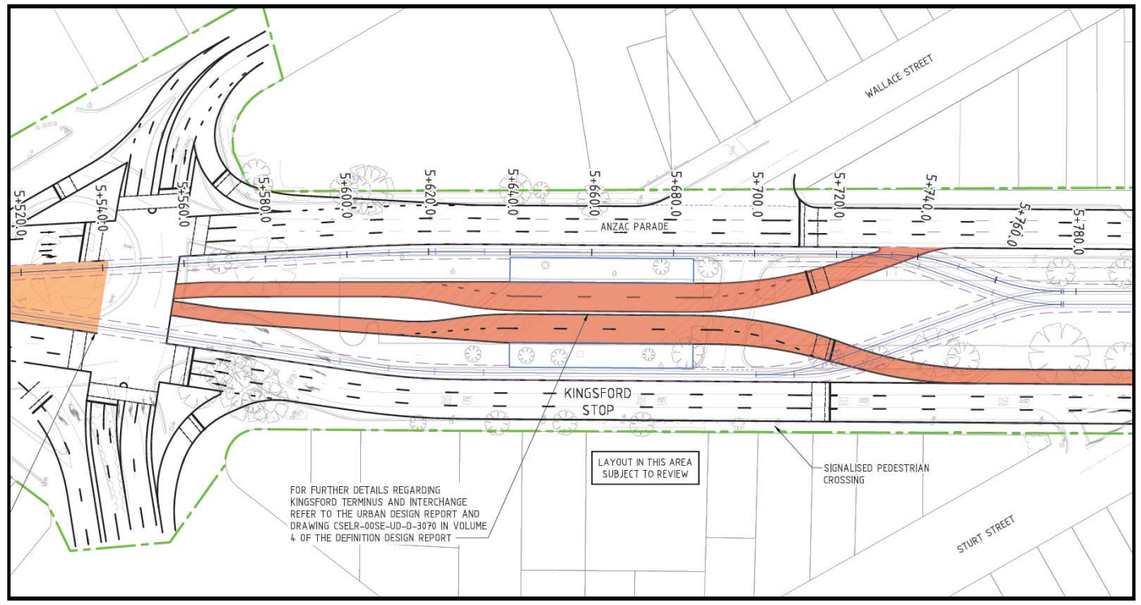
View South along Anzac Parade (to Nineways)

Figure 20: Kingsford Terminus – Photographs

## 10.2 PROPOSED CONDITIONS

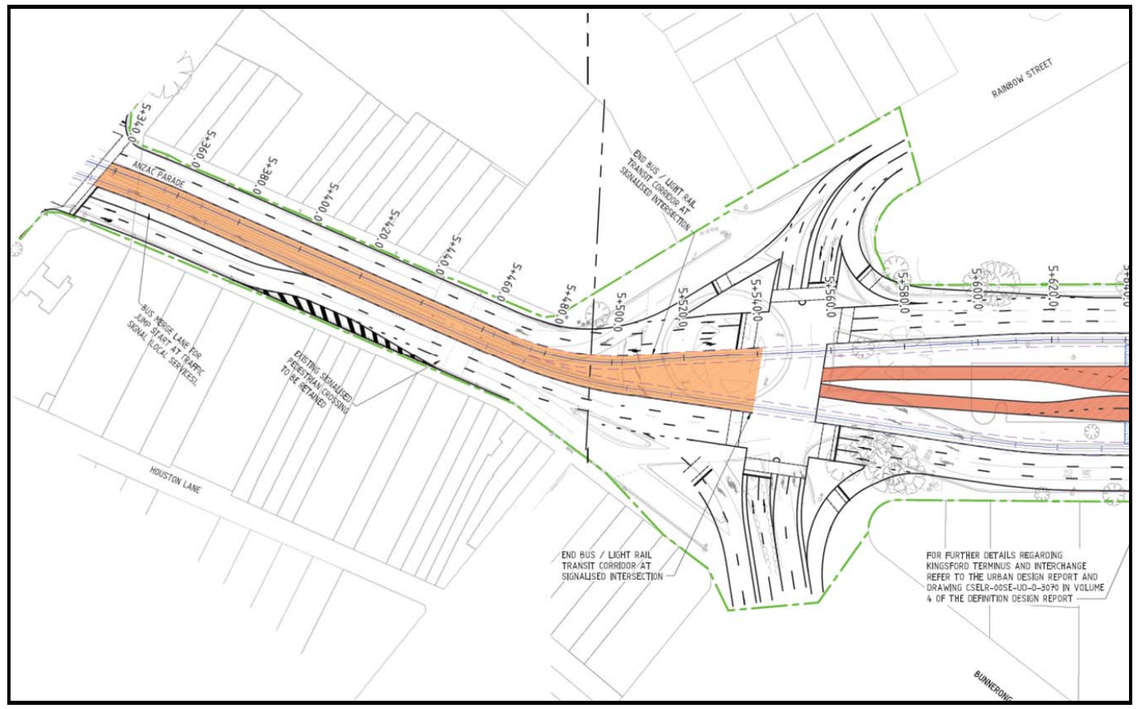
It is proposed to construct (as shown in Figure 21 and Figure 22):

- Stops in centre median to allow transfers between LRV and buses.
- New light rail tracks and bus lanes in centre median.
- Retention of three traffic lanes in each direction.
- Terminus located south of stops.
- Conversion of Nineways roundabout to signalised cross intersection.




Source: Transport of NSW

Figure 21: Kingsford Terminus – Proposed Conditions



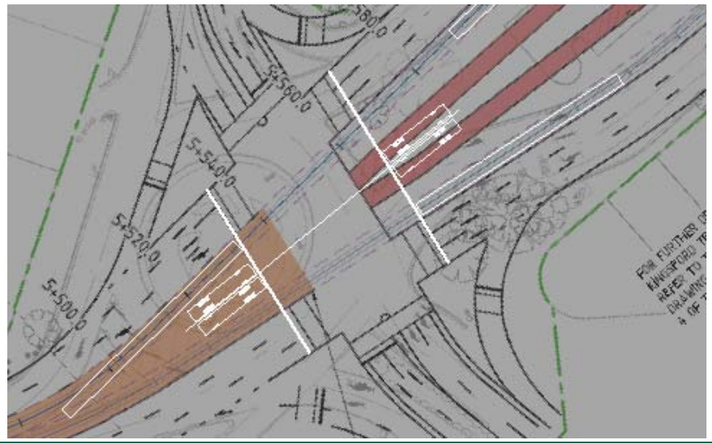

Source: Transport of NSW

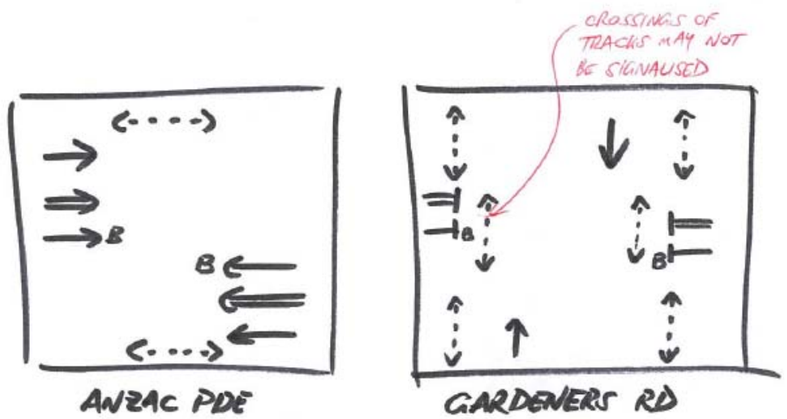
Figure 22: Nineways – Proposed Conditions

## 10.3 ISSUES / OPPORTUNITIES

The findings from the review of this location are included in Table 5.

Table 5: Nineways Intersection

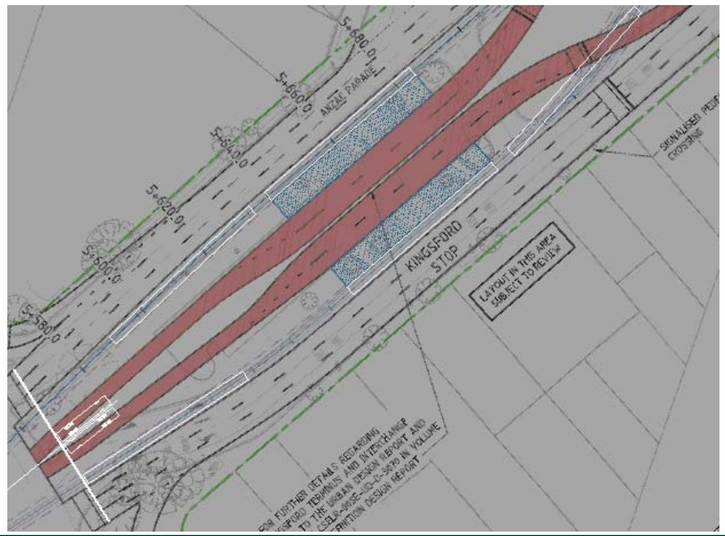
| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| Consistency | - | - | The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. It has been assumed that the Stop Plans are the basis for comment. | Update plans to be consistent. |
| Location | Surrounding Land Uses | Intersection located at southern end of Kingsford commercial area. Signalised cross intersection at Nineways. | Safe pedestrian access around the commercial area and to / from the stops will be improved with the replacement of the roundabout with a signalised cross intersection at Nineways. | Nil. |
| | Land Acquisition | - | Nil. | Nil. |
| Layout | Platform Size | - | Nil. | Nil. |
| | Storage | No pedestrian storage provided between traffic lanes and light rail tracks.<br>No designated area for buses on north side of intersection. | No room between road and tracks for pedestrians to store. This means that it will be more difficult to provide additional priority phases for LRV / buses as pedestrians will need to cross traffic lanes and tracks in one movement. Pedestrian push buttons would need to be provided on the inside of the tracks and there would be no room for signal pedestals between the tracks and the traffic lanes (which are a good way of 'separating' the traffic and LRV / bus movements). At most other locations, these types of crossings will be LRV priority crossings. All pedestrians on the north side of the intersection will be crossing the full width of Anzac Parade.<br>The provision of separate lanes for buses to travel through the Nineways intersection (as provided on the south side only) could improve the priority for buses and LRV. Northbound vehicles could travel through the intersection together and then merge on the north side. Alternatively, northbound vehicles could be given separate phases to travel through the intersection.<br>  | Review layout of Nineways intersection to create pedestrian storage areas between the traffic lanes and the light rail tracks.<br>Review layout of Nineways intersection to create bus lanes on the north side of the intersection. |
| | Swept Paths | - | n/a | n/a |
| | LRV | - | Southbound 45m long LRV will block access to potential bus lane on the inside of the light rail tracks. There is sufficient length for second southbound LRV to cross intersection and wait before entering stop. | Nil. |
| | Signal Pedestals | - | There is no room available for signal pedestals to be located between the traffic lanes and the light trail tracks. Large mast arms will be required. The height and location of the large mast arms will need to consider the overhead light rail wires.<br>Signal phasing for the LRV and bus priority will be complex, with requirements for separate lanterns for each of the movements. Creation of a pedestrian storage area between the light rail tracks and the traffic lanes would create space for traffic signal pedestals for pedestrians, traffic, LRV and buses. | Review layout of Nineways intersection to create pedestrian storage areas between the traffic lanes and the light rail tracks. |
| | Traffic Lanes | Southbound – 2 through & 1 right turn.<br>Northbound – 3 through. | The layout at the intersection is significantly different in each direction.<br>Southbound: | Update plans to reflect proposed lane configuration. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | | | There is a left turn slip lane, two through lanes (one 30m short lane) and a right turn lane on the approach. There are three through lanes on the departure. It is assumed that the right turn arrows are incorrect and no right turn is proposed.<br>Northbound:<br>There is a left turn slip lane and three through lanes on the approach. There are three through lanes on the departure. | |
| Access | Crossing Points | Signalised cross intersection, crosswalks across all legs and left turn slip lanes. | Layout provides safe access around intersection except for crossings of the light rail tracks and bus lanes. It is unclear how these will operate with respect to pedestrian movements. | Review layout of Nineways intersection to provide safe pedestrian access across bus lanes and light rail tracks. |
| | Ramps | - | Nil. | Nil. |
| | Illegal Access | - | Signalised crossings are provided for all movements so there should be minimal illegal crossings. However, illegal crossings will occur if the crossings of the light rail tracks and bus lanes are signalised. | Nil. |
| | Safety | - | Illegal access is the main safety issue as discussed above. | Nil. |
| | Footpath / Shared Path | - | Due to the ramp configuration between the stops, it is expected that the majority of pedestrians coming from the Nineways intersection will access their stop from the Nineways intersection (rather than use the internal ramps). | Nil. |
| | Vehicle | - | No right turns permitted from Anzac Parade (it is assumed southbound right turn incorrectly shown on plans). | Nil. |
| Intermodal | Sharing of Tracks | Buses to shared light rail tracks to north of intersection. | As discussed above, review layout for LRV and buses through intersection. | Nil. |
| | Bus Stops | - | Nil. | Nil. |
| | Bus / LRV Transfer | - | Nil. | Nil. |
| | Bus Priority | Buses to shared light rail tracks to north of intersection. | As discussed above, review layout for LRV and buses through intersection. | Nil. |
| Signal Operation | Overview | - | Only east/west through traffic movements (and potentially east/west pedestrians) will conflict with north/south LRV and bus movements. Should be able to introduce relatively easy phasing with advance detection from the Pedestrian Operated Signals to the north and the stop from the south. If pedestrian crossings are set up as LRV priority, then the priority for LRV and bus should work effectively. The main restriction to priority for north/south LRV and buses will be the crossing time required for pedestrians crossing Anzac Parade i.e. even if a LRV is detected on approach, the signals need to wait until the appropriate walk time and clearance time has finished.<br>  | Review pedestrian crossings of central median – signalised or LRV priority. |
| | LRV Movements | - | Nil. | Nil. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | Bus Movements | - | Nil. | Nil. |
| | Pedestrian Movements | - | Nil. | Nil. |
| | Traffic Impacts | - | Nil. | Nil. |

The findings from the review of this location are included in Table 6.

Table 6: Kingsford Stop & Terminus

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| Consistency | - | - | The 'Road Engineering' plans and the 'Stop Plans' show different configurations for the pedestrian crossings. It has been assumed that the Stop Plans are the basis for comment. | Update plans to be consistent. |
| Location | Surrounding Land Uses | Intermodal transfer stop. | Stop will be a major intermodal transfer stop with a predicted low number of 'walk up' passengers.<br>Terminus could be located further south to reduce the loss of car parks within the central median. | Nil. |
| | Land Acquisition | Car park to east of Anzac Parade. | If used as a Park and Ride location, need to consider how passengers access the stop. | Review passenger access from Park and Ride area to stop. |
| Layout | Platform Size | Both island platforms 45.0m x 6.0m = 270 sqm. | Precinct Access Plan (Table 7-18) states:<br>1,454 boardings & 515 alightings forecast for 2021 (total – 1,969).<br>1,851 boardings & 615 alightings forecast for 2036 (total – 2,466).<br>Platform stops easily able to accommodate pax numbers. | Nil. |
| | Storage | Stops have been designed to facilitate predicted high number of transfers. | Nil. | Nil. |
| | Swept Paths | - | The swept paths for LRV and buses will increase on the track curves to and from the terminus. | Need to ensure all roadside furniture, stop lines and pedestrian storage areas are setback to cater for the increased clearance requirements. |
| | LRV | - | There is sufficient length for second southbound LRV to cross intersection and wait before entering stop.<br>Room for one northbound LRV to store within the terminus and another one waiting at the Nineways intersection. However, no room for additional LRV to store outside of the terminus waiting to enter (northbound) as it will block the bus entry and potentially the pedestrian access.<br>  | Review layout to reduce risk of additional LRV blocking the bus and pedestrian access. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | Signal Pedestals | - | Signal pedestals may be required if bus / LRV interaction is to be controlled. | Review how signal control will be provided. |
| | Traffic Lanes | 3 lanes in both directions. | Nil. | Nil. |
| | Parking Lane | - | It is assumed that some on road parking will continue to be provided. | Nil. |
| Access | Crossing Points | Access to stop from Nineways intersection and Pedestrian Operated Signals. | The Wallace Street Pedestrian Operated Signals are located too close to the Wallace Street intersection e.g. left turners from Wallace Street may not see signals. Also, stop line for Pedestrian Operated Signals should be 6m back from crosswalk.<br>It is unclear if the South Juniors Pedestrian Operated Signals remain. Some pedestrians may use this location to access the central median to walk to the stop. Also, if centre median parking is retained, there may be a number of pedestrians who walk along the centre median to reach the stop. No footpaths are shown in the central median.<br>There is no storage between the traffic lanes and the light rail tracks for pedestrians. In addition, they also have to get across the bus lanes. Different crossing locations are proposed on different plans. On the Stop Plans, the pedestrian crossing point is located very close to the southbound bus stop, which may reduce visibility to pedestrians using the crossing. | Review layout of Wallace Street Pedestrian Operated Signals, including signalisation of the Wallace Street left turn (amber / red when crossing activated, Give Way at other times).<br>Review layout of central median and accommodate pedestrian movements if required.<br>Review layout of pedestrian crossings across the traffic lanes, and within the stop area. |
| | Ramps | Back to back ramps at each end to provide transfers. | Back to back ramps required due to level differences. The number of transfers between stops is expected to be low. At the northern end, it is expected that most pedestrians will choose which stop to access from the Nineways intersection. The location of bicycle storage cages will also influence the use of the ramps. | Nil. |
| | Illegal Access | - | There is the potential for illegal access along Anzac Parade between Nineways and the Pedestrian Operated Signals, how this expected to be relatively low. | Consider the provision of fencing between the traffic lanes and the light rail tracks. |
| | Safety | - | Illegal access is the main safety issue as discussed above. | Nil. |
| | Footpath / Shared Path | | Nil. | |
| | Vehicle | Central median break opposite Wallace Street to be closed. | The Wallace Street intersection could be reconfigured as only left in and left out movements will be permitted. A traffic island could be installed or the intersection realigned to reduce vehicle entry speeds from Anzac Parade. Pedestrian movements across this intersection may increase from the car park to the west of Anzac Parade to the stop access immediately south of Wallace Street.<br>One of the reports indicates that a Kiss and Ride area should be created – this is supported as otherwise kiss and ride activities will occur throughout the area. This is not shown on the plans. The location of the Kiss and Ride area should be close to the stops and close to a signalised crossing point if located on the left hand side of the road. | Review layout of Wallace Street intersection.<br>Review provision of Kiss and Ride area. |
| Intermodal | Sharing of Tracks | LRV and buses will share tracks north of the Nineways intersection. | As discussed above, unclear how LRV and bus movements will be controlled across Nineways intersection. | Review control of LRV and bus interaction. |
| | Bus Stops | - | It is unclear if bus stops on Anzac Parade will be retained. If so, they will only be for local services. Access from the bus stops to the LRV stops needs to be considered. | Review access between local bus stops and LRV stops. |
| | Bus / LRV Transfer | - | Stop will be a major intermodal transfer stop with a predicted low number of 'walk up' passengers. | Nil. |
| | Bus Priority | - | As discussed above, unclear how LRV and bus movements will be controlled within terminus area. | Review control of LRV and bus interaction. |
| Signal Operation | Overview | - | There will be some interaction between buses and other traffic when southbound buses exit the stop back on to Anzac Parade. | Nil. |
| | LRV Movements | - | n/a | n/a |
| | Bus Movements | - | There is no provision for bus entry and exit for local buses between stop and Nineways to remove buses from Nineways intersection. Future provision for these movements should be provided so that any route changes, or the removal of the buses from the light rail tracks further north, could be accommodated.<br>Bus movements exiting the stop will require southbound traffic on Anzac Parade to be stopped. The Pedestrian Operated Signals near Wallace Street could be used | Review layout to make provision for bus entry and exit movements to the north of the stop but south of the Nineways intersection.<br>Review control of southbound bus movements exiting the stop. |
| | Pedestrian | Inconsistency between Road Engineering and | The plans appear to show signalised crossings of bus and light rail tracks. However, it is unlikely that pedestrians will obey the signals. LRV or bus priority crossings are expected to be more suitable to this | Review control of pedestrian crossings. |

| Category | Sub-Category | Proposed Conditions | Issue / Comment | Potential Alternative / Mitigating Measure |
|---|---|---|---|---|
| | Movements | Stop Plans. | environment, subject to the control of LRV and bus conflicts. | |
| | Traffic Impacts | - | Expected to be minimal traffic impacts. Wallace Street Pedestrian Operated Signals could be linked to Nineways intersection located approximately 150m to the north. | Review linking of Pedestrian Operated Signals. |